भारतीय मानक

Indian Standard

IS 3661 : 2023

थोक दूध ठंडा करने का टैंक — विशिष्टि

(दूसरा पुनरीक्षण)

Bulk Milk Cooling Tanks — Specification

(Second Revision)

ICS 65.040.10

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Dairy Products and Equipment Sectional Committee, FAD 19

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Dairy Products and Equipment Sectional Committee had been approved by the Food and Agriculture Division Council.

The bulk milk cooling tank is intended to cool and store milk in chilled condition. The equipment is designed for bulk refrigeration of fresh raw milk and storage of refrigerated raw milk.

This standard was first published in 1966 and covered only rectangular tank geometry. In view of the technical advances in the bulk milk cooling technology, the standard was revised in 2019 to incorporate a number of different bulk milk cooling geometries (rectangular, vertical, cylindrical, open horizontal-semi cylindrical, horizontal cylindrical, elliptical, etc) and capacities varying from 250 litres to 20 000 litres, which are being used in the industry. Also, the specifications were updated and standard was made at par with international standards.

This second revision has been brought out to update the clauses on agitator, milk thermostat, dipstick, air ventilator, type of refrigerant used, switch gear, testing of electrical equipment, hygiene and CIP system, testing conformance for thermal resistance, cooling tests, protection by outer casing and covers against ingress of water, etc. Provision/clarification has been given for use of test liquid other than milk for testing certain requirements. References of Indian Standards have also been updated.

The composition of the committee responsible for formulation of the standard is listed in Annex E.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

BULK MILK COOLING TANKS — SPECIFICATION

(Second Revision)

1 SCOPE

1.1 This standard specifies methods of test and requirements for design, construction and performance of bulk milk cooling (BMC) tanks. It applies to bulk milk cooling tanks with automatic control intended for fixed installation in farms or at milk collecting points.

1.2 It only applies to tanks for two milkings (in 24 h) and four milkings (in 48 h).

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Annex A.

3 TERMS AND DEFINITIONS

For the purpose of this Indian Standard, the following definitions shall apply.

3.1 Bulk Milk Cooling Tanks — An equipment used for bulk refrigeration of fresh raw milk and bulk storage of refrigerated raw milk.

3.2 Automatic Control — An arrangement by which the equipment functions without requiring action by the operator under normal operating conditions.

3.3 Atmospheric Tanks — The tank whose inner vessel is designed to operate at atmospheric pressure.

3.4 Agitator — A device for mixing the milk to promote heat transfer and ensure uniform distribution of butterfat and achievement of uniform temperature.

3.5 Reference Position — The position for correct installation and operation of the tank, as stated by the manufacturer.

3.6 Maximum Volumes — The volume (expressed in litres) to which the inner vessel can be filled without overflowing in its reference position and without agitation.

3.7 Gross Volume — The volume (expressed in litres) to which the inner vessel can be filled without overflowing in its reference position and with agitation.

3.8 Rated Volume — The volume (expressed in litres) of maximum permissible filling of the tank under operating conditions, as specified by the manufacturer.

3.9 Direct Cooling System — The system in which the evaporator of refrigerating system is in direct thermal contact with the milk or the inner vessel.

3.10 Milking — It is the quantity of milk added to the tank at one milking operation.

3.11 Tank for Two Milkings — Tank is designed for cooling and storing its rated volume every 24 h and intended to be emptied for milk collection each day.

3.12 Tank for Four Milkings — Tank is designed for cooling and storing its rated volume every 48 h and intended to be emptied for milk collection every two days.

3.13 Normal Operating Conditions — The conditions when the tank is in use for the cooling and storage of milk in accordance with its design requirements and all accessories are functioning effectively.

3.14 Ambient Atmosphere — The atmosphere surrounding the tank and in front of the air-cooled condenser of the refrigerating plant.

3.15 Ambient Temperature — The average temperature of the ambient atmosphere.

3.16 Performance Temperature (PT) — The ambient temperature when milk cooling time is measured.

3.17 Safe Operating Temperatures (SOT) — The higher limit (range) of ambient temperatures at which the tank/equipment is expected/required to function effectively.

3.18 Initial Temperature — The average temperature of the milk at the time of its entry into the tank.

3.19 Storage Temperature — The average temperature to which the milk is reduced (cooled) by cooling for storage.

3.20 Cooling Time — The time required for cooling a milking from initial temperature to + 4 °C.

3.21 Cooling Cycle — The time period between two successive milk collections. For tanks, the cooling cycle is 24 h for two milkings and 48 h for four milkings.

3.22 Specific Energy Consumption — The energy consumption measured as the average consumption of all components (excluding cleaning) during a cooling cycle under the testing conditions appropriate to the performance class. It is generally expressed as watt hours per litre cooled milk (Wh/litre).

3.23 Milk — The normal mammary secretion derived from complete milking of healthy milch animal without either addition thereto or extraction therefrom.

3.24 Water — The water, suitable for human consumption which is as per the requirements specified in IS 10500.

3.25 Test Liquid — The water used, in place of milk, for test purpose.

NOTE — The cooling time for water is almost same as that for milk.

3.26 Filling — It is measured volume of milk in the tank, at 4 °C.

3.27 Temperature of the Milk — The average temperature of milk at a particular moment.

3.29 Hot Point of the Milk — The maximum temperature of milk at a given point during storage.

4 REQUIREMENTS

4.1 Tank Construction

4.1.1 *General*

The equipment shall be designed for bulk refrigeration of fresh raw milk and storage of refrigerated raw milk. The tank shall be so designed that, all surfaces in contact with milk are readily accessible for either manual cleaning or cleaning in place (CIP). The tank shall consist of an inner vessel, an outer shell, a suitable insulation layer, a milk collection/receiving opening, a milk outlet, an agitator for agitation, a measuring device/system for volume and temperature of milk as basic requirement (*see* Fig. 1).

The dimensions of the equipment shall be so designed that milk collection, discharge and inspection should not be a constraint at any condition. In case of such limitation with respect to optimum design standard, suitable arrangements shall be provided with the equipment to overcome the issues against above potential requirements. Stainless steel filters shall be provided at the top of balance tank or an inline stainless steel filter shall be provided between balance tank and milk pump or both may be provided.

4.1.1.1 The tank and the associated equipment shall be designed to provide sufficient mechanical strength for transportation and handling and to give satisfactory and safe operation under normal condition.

4.1.1.2 It shall be so constructed as to prevent any contamination of milk and any corrosion of materials of construction and enable cleaning, disinfection and inspection to be carried out without difficulty.

4.1.2 *Classification and Design*

4.1.2.1 The tanks are classified as follows:

a) Based on rated capacity

Each bulk milk tank shall be designated by its rated capacity. This shall be the maximum volume of milk for which the tank is designed to operate and shall be tested.

b) Based on accessibility:

1) Open type (*see* Fig. 2A)
2) Closed type (*see* Fig. 2B)

Open type bulk milk coolers shall be designed for manual cleaning and for closed type bulk milk coolers, cleaning-in-place (CIP) should be adopted.

c) Based on construction:
   1) Vertical
   2) Horizontal

d) Based on shape:
   1) Rectangular
   2) Cylindrical
   3) Elliptical
   4) Semicircular
   5) Polygon

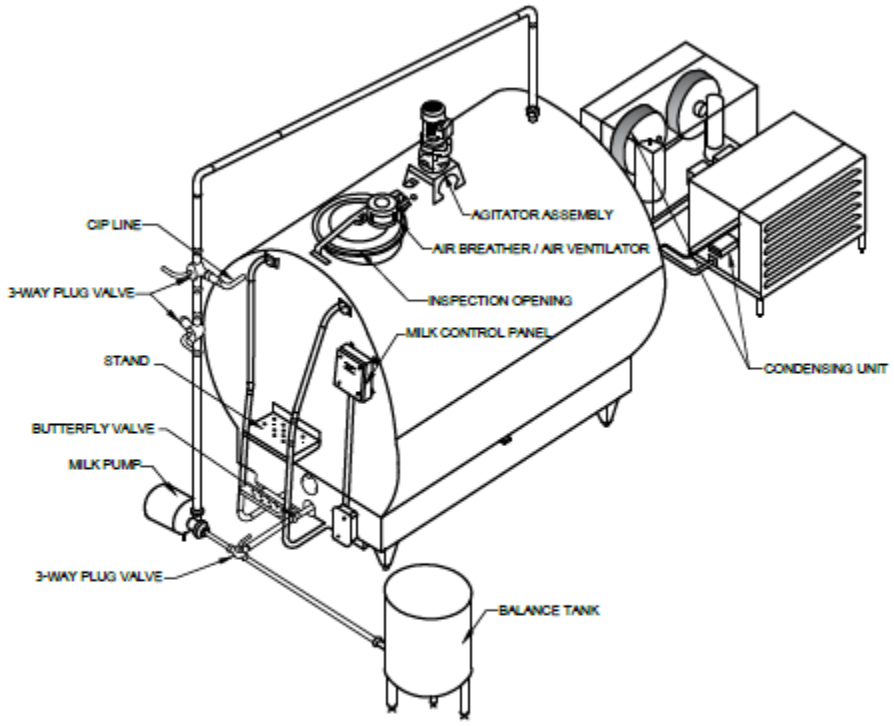

FIG. 1 TYPICAL BULK MILK COOLING TANK

4.1.2.2 All component parts, the surfaces of which come into contact with milk, shall be made of stainless steel of designation SS 304 (Austenitic X04 Cr19 Ni9) conforming to IS 5522 or IS 6911.

NOTE — It is recommended that CIP tapping to the spray balls are self-drainable to prevent stagnation of milk/CIP chemicals in the pipelines.

4.1.2.3 All other parts, the surfaces of which do not come into contact with the milk, shall also be made of stainless steel of designation SS 304 (Austenitic X04 Cr19 Ni9) conforming to IS 5522 or IS 6911.

4.1.2.4 Materials used for gaskets or rubber parts shall be non-toxic, resistant to cleaning and disinfecting agents under normal conditions of temperature and dosage and shall not impart taint to milk.

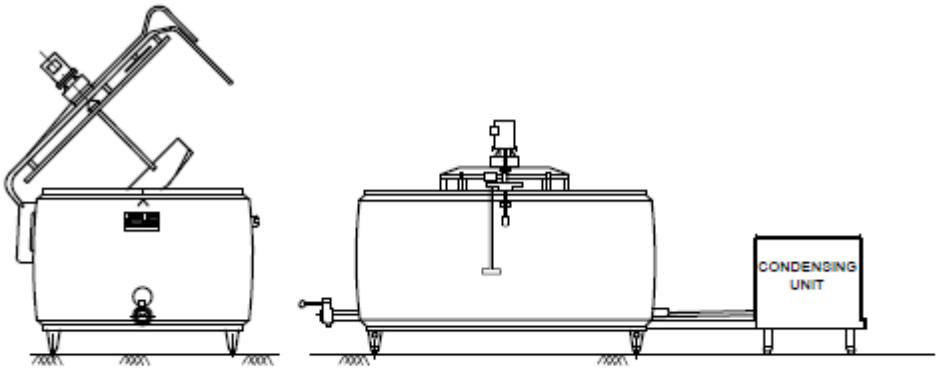

FIG. 2A OPEN TYPE BULK MILK COOLING TANKS

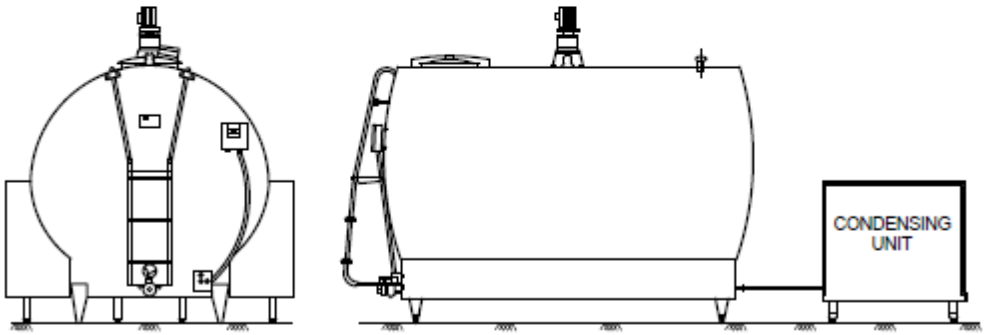

FIG. 2B CLOSED TYPE BULK MILK COOLING TANK

FIG. 2 BULK MILK COOLING TANK BASED ON ACCESSIBILITY

4.1.3 *Inner Vessel*

The inner vessel shall be so designed that the available volume of the tank should be 8 percent to 10 percent more than the rated volume at which it shall be tested, to avoid agitation spillage. Every component which is permanently attached within the inner vessel shall be tungsten inert gas (TIG)/laser welded to it. The weld joints to be used with filler material should be compatible with the parent metal. All components for which it is not practical to weld the same to the inner vessel, shall be fastened so that they can be easily removed for cleaning. All metallic surfaces including weld joints of the inner vessel should be ground smooth not less than 150 grit (or welds shall have radii not less than 3 mm and the angles shall be not less than 1.57 rad, that is 90°). If the tank is fitted with automatic or semi-automatic cleaning equipment, care shall be taken to ensure that all internal surfaces of the inner vessel can be cleaned effectively as per needs when the equipment is used in accordance with the manufacturer's instruction. If the tank is equipped with a device for measuring the volume of milk by reference to linear measurements in accordance with the regulations of the relevant authorities, the inner vessel shall be so constructed and supported that it is rigid and free from deformation under normal conditions of transport and use.

4.1.3.1 Actual capacities shall be determined with the tank filled to a level that the sprayers and sprinklers for clean-in-place (CIP) provision shall not come in contact with the milk and milk should not drain outside via the washing spray system, for example rotary sprayer and sprinklers/spray jet with forks and deflector plate.

4.1.3.2 All welded joints shall be free from porosity and brittleness. The joints shall be well-dressed and finished smooth, particularly those joints which come into contact with milk.

4.1.3.3 The breast piece/cover shall be made of stainless steel of designation SS 304 (Austenitic X04 Cr19 Ni9) conforming to IS 5522.

4.1.3.4 Any permanent attachment to the inner vessel shall be welded with fillet of radius not less than 3 mm.

4.1.3.5 Where separate from the sheathing, the

breast piece/cover shall be turned downwards to form either a lap joint or butt joint. In case of lap joint, the overlap shall not be less than 15 mm and lapping edges to be welded smoothly.

4.1.3.6 All parts of the inner vessel shall drain directly to the outlet through an outlet valve. It shall have the following features:

a) In vertical cylindrical tanks, the slope of the chord(s) from the internal corner at the bottom of the vertical sides shall be free draining. With the tank in its reference position and containing 40 litres of milk, at least 39.8 litres shall run out in 1 min by gravity;
b) Rectangular tanks with shallow V-bottom shall have a longitudinal fall not less than 1 in 25 combined with a transverse fall to the longitudinal axis also not less than 1 in 25 to the horizontal or the slope may be ensured by inclining the tank/adjusting the feet; and
c) All inside corners of the inner vessel which form an angle of less than 2.36 radians (135°) shall have radii not less than 25 mm. All other corners in the inner vessel shall have radii not less than 3 mm (*see* Fig. 3).

4.1.4 *Outer Casing*

The outer casing shall be rigid, shall prevent the ingress of water and shall be free draining. The distance between the outer casing of the tank and the floor shall be such that, the base of the tank (except the supports or feet and the outlet pipe) when installed on a horizontal floor shall be situated above two imaginary planes, having a gradient of 1 in 10 to the horizontal. The line of intersection being horizontal and minimum 100 mm above the floor (*see* Fig. 4).

4.1.4.1 The specified bottom clearance will increase depending upon the geometry, number of bends, angle of inclination and outlet length. The ground clearance under the outlet fitting shall not be less than 100 mm.

4.1.4.2 If the tank is designed to be installed on a solid plinth, the above requirement does not apply, but precaution shall be taken to ensure that water shall not enter between the tank outer casing and solid plinth.

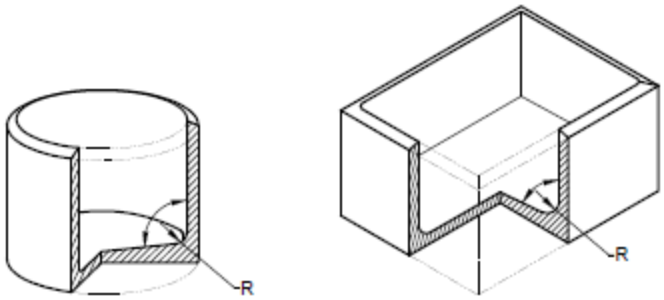

FIG. 3 EXAMPLES OF INNER CORNERS LESS THAN 2.36 RADIANS, (135°) WITH RADII R

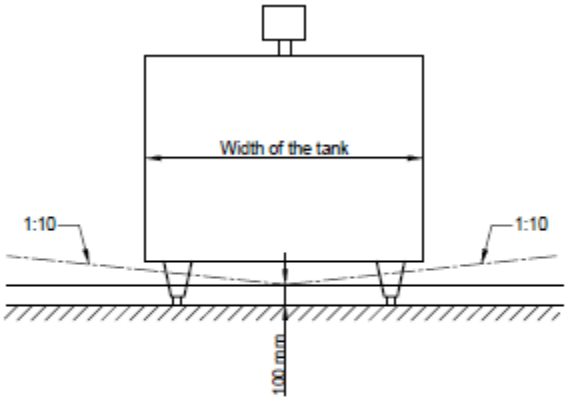

FIG. 4 CLEARANCE BETWEEN TANK AND FLOOR

4.1.4.3 The outer casing of the tank shall be made of stainless steel of designation SS 304 (Austenitic X04 Cr19 Ni9) conforming to IS 5522 or IS 6911.

4.1.4.4 While designing the tank, outer casing shall be designed with suitable number of air vents at the bottom for void free insulation in between inner vessel and outer casing. The vents to be plugged properly with suitable water and corrosion resistant non-toxic food grade material to prevent any insulation damage by external means.

4.1.4.5 The outer casing of the tank shall be designed such that, connections for cleaning in place (wherever applicable), and refrigerant charging and agitator shaft holder shall not get damaged during assembly and transportation.

4.1.4.6 The outer casing shall be constructed and assembled on the inner vessel in such a way that, inner vessel horizontal slope shall be accommodated with a calculated gap from one end to the other to prevent under insulation or over insulation thickness.

4.1.4.7 The outer casing surface finish shall be maintained uniformly throughout the tank externals if designed with butt or overlap weld joints.

4.1.4.8 Any part of the outer casing which is not vertical shall be designed to drain effectively.

4.1.5 *Thermal Insulation*

The insulating material shall be non-settling and shall not be liable to displacement during transit or service. The sides, ends, bottom and top of the tanks shall be insulated to reduce stray heat gains during cooling or refrigerated milk storage. The open type tanks shall be insulated from the sides, ends and bottom except top cover.

4.1.5.1 The amount of insulation applied shall be such that the rise in the mean temperature of the content of a full tank at rated capacity initially at 4 °C over a period of 12 h at performance temperature (38 °C for Class A) shall not exceed 3 °C.

4.1.5.2 The insulating medium to be employed shall be injectable polyols and isocyanides polyurethane foam (PUF) and shall be non-hygroscopic and non-settling type.

4.1.5.3 An effective vapour barrier shall seal the external surfaces of the insulating medium and prevent the ingress of moisture.

4.1.5.4 The insulation medium used and thickness of the insulation shall not create any adverse effect on thermo wells, thermometers, thermostats and temperature sensors.

4.1.6 *External Finish*

4.1.6.1 Vertical joints in the outer casing shall be sealed by lapping. Cover strips, where used, shall be overlapped by the breast piece at their upper ends by not less than 10 mm each side. In case of butt joint in outer casings, the welding bead shall be made smooth enough to visualize as an integral part.

4.1.6.2 Any part of the outer casing which is not vertical shall drain effectively. The tank should be designed in such a manner that no stagnation of liquid shall occur on the outer shell.

4.1.7 *Inspection Openings in Breast Piece and Sheathing*

The tank shall be designed and constructed with an opening for inspection of the tank along with all sorts of volume and temperature control systems incorporated in the tank internally. These tanks shall have minimum one opening with dimensions at least 400 mm × 300 mm elliptical and for small tanks with open type design shall have minimum one opening with a diameter not less than 180 mm.

4.1.7.1 Inspection panels or apertures of sufficient size shall be provided to facilitate access to thermometer sensitive elements, thermostats or other components for inspection or replacement.

4.1.7.2 Inspection opening in nearly horizontal surfaces in breast piece and sheathing shall be provided with:

a) Up stands of not less than 10 mm,
b) Covers with down turned edges to overlap the up stands by not less than 5 mm, and
c) Covers with handles or lifting knobs.

4.1.7.3 Inspection openings in vertical surfaces in the sheathing shall be provided with covers which shall,

a) Be overlapped on the upper edge by 15 mm,
b) Overlap all edges except the upper by 15 mm,
c) Be provided with a suitable seal/gasket all around the overlap edges, and
d) Be positively retained in position.

4.1.8 *Tank Supports*

A tank which is not designed for a mounting on a solid plinth shall be fitted with adjustable support of feet to permit a slope gradient not greater than 1 : 50 in any direction.

4.1.8.1 The rigid supports provided on the tank should be made of stainless steel of designation SS 304 (Austenitic X04 Cr19 Ni9) conforming to IS 5522 or IS 6911 with sturdy design. The number and position of support/feet shall be adequate to carry the load.

4.1.8.2 When the tank is installed, these supports shall be readily accessible, and shall be positioned not less than 350 mm from the nearest tank wall, unless the latter is curved in the vertical plane to give access to the underside of the tank.

4.1.8.3 If the tank is equipped with a device for measuring the volume of milk by reference to linear measurement, the support or feet shall be so constructed that they can be sealed after the tank has been levelled.

4.1.9 *Bridge*

Any bridge or bracket or gusset required to be supported from the inner vessel shall be welded to the it, shall be provided with upturned edges not less than 10 mm high and shall be sloped to drain clear of the inner vessel. Every component which is permanently attached to the bridge shall be welded to it.

4.1.9.1 Bridges covering one end or segment of a tank shall be inclined at a minimum of 1 in 10 to the horizontal with the help of an adjustable leg lift.

4.1.9.2 All bridges and apertures therein shall be provided with upstanding edges not less than 10 mm high, except that apertures smaller than 75 mm in diameter may have up stands not less 5 mm high. Surfaces shall be sloped to discharge any accumulation of moisture clear of the open tank top.

4.1.10 *Main Covers for Inner Vessel*

The covers for the tank designed to be cleaned manually shall be lockable and so constructed that these can be operated sufficiently to enable all parts to be cleaned easily by hand. Safe support shall be provided for hinged covers in the open position. In case of open type tanks, where the breast piece act like a cover, it shall be so designed and constructed that, the cover is positioned at an elevation of 78° to 88° to the horizontal plane without falling down automatically. The open type tanks shall be designed to keep it in opened condition to an elevation of 40° to 55° to the horizontal by a stopper.

4.1.10.1 One or more close fitting covers, so designed as to lift off when desired, shall be provided for openings in the top of the tank. Covers shall be sloped to the outside to provide free drainage for any moisture and shall be turned down at the outer edge to overlap the up stand.

4.1.10.2 Covers shall be provided with means to support them in the open position. Covers shall allow easy inspection and sampling of the milk and operation of the outlet control and dipstick (where provided).

4.1.10.3 Covers shall be made out of stainless steel of designation SS 304 (Austenitic X04 Cr19 Ni9) conforming to IS 5522 or IS 6911.

4.1.10.4 All apertures shall be provided with upstanding edges, and separate removable covers shall be provided to fit over the apertures. The up stand shall be not less than 5 mm for apertures up to 75 mm in diameter and 10 mm for all others. Downturned edges of aperture cover shall be not less than 10 mm.

4.1.10.5 Where covers are intended to support strainers or hoppers for milk reception, the design shall be such that the whole of the body of the strainer or hopper is at all times completely above the level of the milk when the tank is filled to a level 30 mm below the lowest point on the up stand of the inner vessel, and the covers shall have sufficient strength to support the additional loads involved.

4.1.10.6 All handles attached to covers shall be external and unless of integral construction shall be attached by welding to provide smooth hygienic surfaces.

4.1.10.7 Internal radii of covers shall not be less than 3 mm.

4.1.10.8 The covers for tanks designed to be cleaned manually shall be so constructed that they can be opened sufficiently to enable all parts to be cleaned easily by hand. Safe support shall be provided for hinged covers in the open position. Provisions shall be there to ensure the safety of the operator during cleaning.

4.1.10.9 The covers for tanks designed to be cleaned by non-manual methods shall permit inspection of all parts which may come into contact with milk.

4.1.11 *Fabrication and Surface Finish*

The tank and associated equipment shall be designed to provide sufficient mechanical strength to allow transportation and handling and give satisfactory and safe operation under normal condition. It shall be so constructed as to prevent any contamination

of the milk and any corrosion of the material of construction and to enable cleaning, disinfection and inspection. The tank shall be fabricated so as to enable ease of material handling and packing to prevent any damage during transportation, installation and commissioning. All metallic surfaces including weld joints shall be ground smooth not less than 150 grit (or welds shall have radii not less than 3 mm and the angles shall be not less than 1.57 rad that is 90°).

4.1.11.1 The bulk milk cooling tank shall be fabricated in such a manner as to conform to the requirements laid down in the standard.

4.1.12 *Tank Fittings*

4.1.12.1 *Outlet*

The tank shall be provided with an outlet orifice and the bottom of the inner vessel shall be designed so that all the wash water drains to the outlet. When the outlet is designed to be used also as a milk outlet, the following requirements shall apply:

a) The tank outlet connection shall be self-drainable/gravity drainable to avoid stagnation of milk or cleaning/sanitation chemicals. The highest point on the inside of the outlet end of the outlet pipe (*see* Fig. 5) including the outlet valve, shall be lower than the lowest part of the bottom of the inner vessel. This shall be verified by drainability test (with the tank in its reference position and containing 40 litres of test water, at least 39.8 litres shall run out in 1 min by gravity),

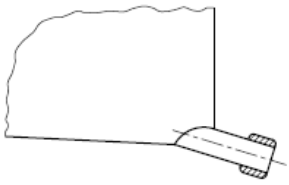

FIG. 5 OUTLET POSITION (BROKEN LINES HORIZONTAL)

b) The outlet pipe shall be not less than 50 mm diameter stainless steel pipe (*see* IS 3382) and shall be welded to the inner vessel. If not of one piece, the pipe shall have not more than one joint situated externally and in an accessible position. The joint shall be of clean-in-place (CIP) type,

NOTE — The distance between the outlet valve seat and the tank should be as minimal as possible to avoid milk stagnation in ambient temperature. Recommended distance is 1.5 diameter of the pipeline.

c) The bend in the outlet pipe shall have a mean radius of not less than 75 mm. A clearance of 100 mm to be maintained from the lowest tip of the outlet pipe to ground as shown in the Fig. 6,

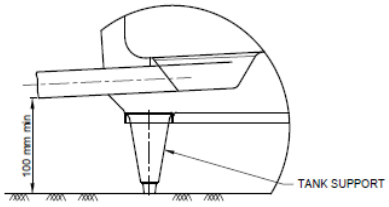

FIG. 6 OUTLET POSITION

d) In all cases the outlet shall terminate in a 50 mm ring joint male end and shall be provided with a blank cap and nut,

e) The outlet pipe shall be as short as is reasonably practicable. Clearance shall be provided to permit the use of a union nut spanner, and

f) In case the manufacturer is using well design with a tank in reference position, the well shall be not less than 25 mm deep at the outlet orifice. If circular, the diameter shall not be less than 100 mm nor more than 200 mm. If elongated, the length and width each shall not be less than 100 mm nor more than 200 mm. The outer end of the outlet pipe shall emerge from the casing on an inclination as shown in Fig. 7 to drain the milk and wash water completely.

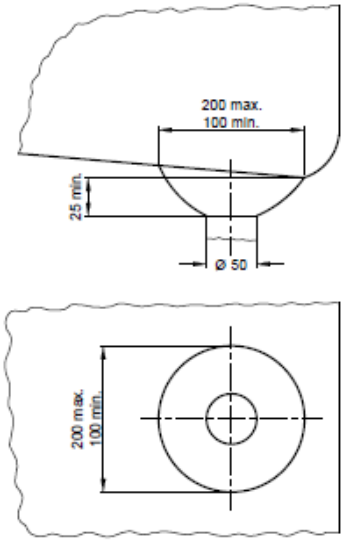

FIG. 7 DIMENSIONAL CRITERIA FOR OUTLET WELL

4.1.12.2 *Outlet control*

The outlet shall be lockable and provided with a control consisting either of a hygienic cock or of a hygienic plug and rod device. The arrangement shall be such that:

a) the plug does not need to be clamped in position in order to seal,
b) means are provided for retaining the plug and rod in the open position clear of the milk agitator, and
c) there shall be no detachable components capable of passing down the outlet of the tank.

4.1.12.3 *Agitator*

The tank shall be provided with a suitable type of agitator (*see* Fig. 1) designed to promote effective heat transfer and thorough mixing of the milk without churning the milk fat, or spillage of milk at any filling level up to 30 mm below the lowest point on the up stand of the inner vessel. The product contact part of the agitator shall be made of stainless steel of designation SS 304 (Austenitic X04 Cr19 Ni9) conforming to IS 5522 or IS 6911. Lubricants used in agitator assembly must be non-toxic and of food grade. The agitator shall comply with the following:

a) The agitation device shall be so constructed that shaft seals shall be provided against any contamination of the milk which could enter the inner vessel from outside. A suitable oil cap/catch pan shall be provided to eliminate unexpected oil leak into the milk,

b) All welds on agitator blades and shafts shall have fillet radii of not less than 3 mm. All surfaces of the blades and shafts shall be readily accessible for cleaning. Surfaces other than vertical shall be avoided where possible,

c) The agitator shaft shall be provided with a retractable deflector between the drive units and the bridge or cover over the inner vessel,

d) The deflector (*see* Fig. 8) shall be:

   1) Of stainless steel (SS 304 designation) or non-metallic (non-toxic) material,
   2) Of a close fit on the shaft, and
   3) So designed that in its lower position the aperture round the shaft is closed.

e) Operating the agitator shall not cause milk to overflow when the tank contains any volume of milk up to 100 percent of its rated volume,

f) The performance of the agitator shall be such as to produce throughout the content of the tank filled to 100 percent rated capacity a butterfat distribution uniform to within ± 0.05 of butterfat percentage [*see* IS 1224 (Part 1)] after operation for not more than four minutes in milk that has been cooled to 4 °C and has then remained undisturbed for 6 h,

g) The design of the shaft, deflector and aperture shall be such that these components are readily accessible for cleaning above and below the bridge of cover. The agitator shaft shall incorporate a coupling above the maximum milk level, whereby the blade assembly may be removed from the tank for cleaning,

h) The agitator motor assembly shall be guarded so that operator can not come in contact with moving parts,

j) The agitator shall be so designed that it can be cleaned effectively. If the tank is fitted with an automatic or semi-automatic cleaning equipment, care shall be taken to ensure that the agitator is cleaned effectively when the equipment is used in accordance with the manufacturer's instruction, and

k) In case of open type tanks, the agitator drive unit shall be mounted on the breast piece, the blade of agitator shall become accessible when the cover is raised.

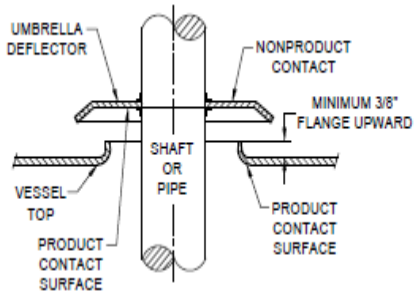

FIG. 8 DEFLECTOR

4.1.12.4 *Milk thermometer*

Every tank shall be provided with an instrument to

measure the temperature of the milk at any volume between 10 percent and 100 percent of the rated volume when filled in from 0 °C to ambient (0 °C to 47 °C). If detachable instruments are used they shall be suspended above the rated maximum level of the milk and shall be easily accessible. The instrument shall be suitably protected to ensure that neither dust nor liquid can enter into it. The instrument shall not penetrate the inner vessel. The tank shall be provided with a suitable temperature transducer for sensing the temperature and transmitting it to the control panel for visualization. It shall also be capable of withstanding, without loss in calibration, temperature inside inner vessel from 0 ºC to 100 ºC and ambient temperature from 0 ºC to the specified safe operating temperature (SOT). In ambient temperature from 5 °C to the specified performance temperature (PT), the error of the instrument shall not be greater than 1 °C, between 2 °C and 12 °C, when the milk temperature is changing at a rate not more than 10 °C/h.

4.1.12.5 *Milk thermostat*

The tank shall be provided with suitable thermostat for control of the cooling system, having external stem surfaces of polished stainless steel. The temperature-sensitive portion of the thermostat shall be so disposed that the instrument operates correctly when the tank contains 10 percent or more of its nominal capacity. It should provide a suitable signal to cut off the BMC at milk temperature of 4 °C (with tolerance of – 2 °C) in the ambient temperature so as to ensure that the temperature of any part of the milk does not exceed 9 °C. The operating head shall be robust and sealed to prevent the ingress of pest, dust or moisture and the minimum IP code shall be IP 23 as per IS/IEC 60529.

4.1.12.6 *Combined milk temperature measuring instrument*

A tank may be designed and constructed so that the milk temperature measuring instrument are synchronized through the controls. In case of direct exchange type cooling systems, the thermometer/temperature transducer (TT) output is connected to refrigeration control panel to make condensing unit ‘ON’ or Auto cut ‘OFF’ mode based on the operational parameters set into the controlling device.

4.1.12.7 *Dip-stick*

Each tank shall be provided with a dip-stick and two dip-stick holders. For closed type tanks, only one dip stick holder may be provided with one dip stick. The reference position of the tank should be given by the height difference in millimetre read on the dipstick at both dipstick holders. The length of the dip-stick shall be such that readings may be taken at 10 percent to 100 percent of rated nominal tank capacity. The surface finish of the graduated face shall be such that an accurate indication of level is given when used with water. With non-automatic or dipstick measuring system, each division on the dipstick shall represent a volume not greater than 0.5 percent of the rated volume. Also, consequently, the permissible error between measured and actual volume should be within + 0.5 percent of the measured volume.

If agreed between supplier and purchaser, the tank may be equipped with an automatic volume measuring device to show the volume of milk on the control panel when the milk in the tank is at + 4 °C to 38 °C. The automatic volume measuring device may be of non-contact type or contact type and the permissible error in volume measurement is not more than 0.5 percent of the rated capacity or 0.5 percent of measured volume of the tank, whichever is less. The automatic volume measuring device should be capable of showing the volume of the milk to the above specification during milk reception and discharge also.

4.1.12.8 *Opening for cleaning*

In closed type bulk milk coolers, the tank shall be provided with one or more cleaning devices of stainless steel of designation SS 304 (Austenitic X04 Cr19 Ni9) conforming to IS 5522 on the top of the tank so as to facilitate thorough cleaning of the tank. In open type bulk milk coolers, the top cover of the tank is lifted for manual cleaning.

4.1.12.9 *Air ventilator*

The closed type tanks shall be fitted with an air ventilator/breather (*see* Fig. 1) to remove entrapped gases, foul odour and air developed during the cleaning process and also converted during milk reception. The air ventilator shall be suitably constructed from corrosion proof material and mounted on the top of the tank, preferably on the manhole cover for easy access. The air ventilator shall be covered such that no foreign matter of size greater than 2 mm can enter into the tank from outside. In open type tanks, no air ventilator is required.

4.1.12.10 *Milk inlet*

The tank shall be provided with not less than one inlet pipe or with not less than one aperture or with both. Where an inlet pipe is part of the tank it shall be so designed that the formation of froth is prevented as far as practicable. Where an inlet perture for pouring milk is provided, it shall

have a diameter of not less than 180 mm.

4.1.12.11 *Balance tank*

The balance tank (*see* Fig. 1), wherever required, shall be of sanitary design, fabricated from stainless steel of designation SS 304 (Austenitic X04 Cr19 Ni9) conforming to IS 5522. Outlet stainless steel cup and sufficient slope shall be provided at bottom of the tank for complete drainage of milk. The dimensions of the tank and fittings shall be suitable to meet milk collection operations at center. A stainless steel removable cover with handle shall be provided. Stainless steel filter made from stainless steel plate of adequate thickness with 2 mm diameter holes (removable type) shall be provided for placement in the balance tank to remove coarse suspended impurities from milk. Three to four ball feet shall be provided for height adjustment of 50 mm. All milk contact surfaces shall be finished to minimum 150 grit.

4.1.12.12 *Stainless steel sanitary milk pump*

The stainless steel sanitary milk pump (*see* Fig. 1), wherever required, shall be supplied for transferring milk from balance tank to the cooling tank and cooling tank to road milk tanker. Pump impeller and casing shall be made of stainless steel of designation SS 304 (Austenitic X04 Cr19 Ni9) conforming to IS 5522. All milk contact surfaces shall be finished to minimum 150 grits. The pump should be of sanitary design. Inlet and outlet of the pump shall have ends with SMS union. The pump shall be provided with approved make motor having E/F class insulation, IP 55 protection and energy efficient. The flanged end motor shall have stainless steel shaft having hygienic mechanical sealing arrangement to prevent leakage from pump casing to rotor side of the motor. Pump shall have stainless steel shroud with air ventilation grill for circulating cooling air. The pump shall have stainless steel adjustable ball feet.

4.1.12.13 *Clean-in-place (CIP) spray balls/spray nozzles for closed type tank configuration*

In case of close tanks, CIP facility shall be provided, which shall include removable stationary 360 degree/self rotating spray ball system positioned at the top of the tank inside and piping from the balance tank through milk transfer pump to the bulk milk cooler.

5 REFRIGERATION

The refrigeration system shall be of direct expansion type.

5.1 General

The refrigeration system cools the raw milk from reception temperature to 4 ºC in the period specified for the cooler.

5.1.1 The TIG/Laser/more advanced welded evaporator(s) of the refrigeration system shall form a part of the milk tank body as dimpled jacket in the inner shell bottom to a height covering the bottom radius all around the rectangular type tanks to provide necessary heat transfer to confirm the performance requirement given in **5.3.1**.

5.2 Type of Refrigerant

5.2.1 Where the refrigeration system used is of direct expansion type, the refrigerants listed in IS 16656 which are permitted under the *Ozone Depleting Substances (Regulation and Control) Rules*, 2000 shall be used.

5.3 Duty

Tanks designed for cooling and storage shall have refrigerating equipment of capacity sufficient to perform the following daily duty, all in an ambient temperature of 38 °C with condenser:

a) Cool 100 percent of nominal tank capacity from 35 °C to 4 °C; and
b) Eliminate all stray heat gains.

5.3.1 Tanks designed for cooling and storage shall have the following milk cooling performance in ambient temperature of 38 °C:

Ambient Temperature

Classification	*Performance Temperature (PT)* °C	*Safe Operating Temperature (SOT)* °C
A	38	43
B	32	38
C	25	32

Milk Cooling Time

Classification	*Cooling Time In Hours*	
	All Milkings 35 °C to 4 °C	*Second Milking* 10 °C to 4 °C
I	2.5	1.25
II	3	1.5
III	3.5	1.75

5.4 Prevention of Freezing of Milk

When the tank is filled between 10 perecent and 100 percent of its rated volume and is used in ambient temperature between 5 °C and the specified performance temperature (PT) ice shall not form in the milk under the milk level either during cooling or during storage.

5.5 Control of Milk Temperature

The milk temperature control system shall:

a) start and stop the main milk cooling operation automatically;
b) operate at any level of filling above 10 percent of rated capacity;
c) terminate the main milk cooling operation at 4 °C for any milk quantity over 10 percent at ambient temperatures between 5 °C and 43 °C; and
d) prevent the milk temperature during storage in 43 °C [Safe Operating Temperature, 43 °C for class (A) ambient temperature] from reaching 9 °C at any point, above 10 percent of rated capacity. For this purpose, overnight storage shall be assumed to be 12 h and day time storage 6 h.

5.6 Construction

In all cases of direct expansion evaporators, the connection of service pipes to the refrigerating jacket shall be by compression joint or screwed joint as appropriate to a tail, half union or socket welded into the jacket. Brazed, silver soldered or soldered joints may also be used.

5.7 Pressure Testing

5.7.1 Evaporators to be charged with dichlorodifluoromethane (CCl_2F_2) or methyl chloride (CH_3Cl) shall be tested with dry nitrogen at a pressure 10 percent over and above the operating pressure of the refrigerant being used at performance temperature specified under **5.3.1**. In cases of other refrigerants, the test pressure shall not be less than the saturated pressure at 65 °C. It is required to ascertain that there is no leakage on evaporator.

5.7.2 After pressure testing the evaporator systems shall be cleaned, dried and sealed and it should be charged with 2 kg/cm^2 dry nitrogen.

6 INSTRUMENTATION AND CONTROL SYSTEM

6.1 Refrigeration Control Panel

The refrigeration unit shall be provided with control panel made out of suitable corrosion resistant non-toxic material suitable for mounting near or on the unit. The panel shall be at least IP 23 degree of protection and provided with motor starters, ON/OFF push buttons and necessary MCBs, control wiring, line voltage controller to guard the compressor against the supply voltage fluctuations. In case more than one compressor is provided in the refrigeration system, the control panel shall be provided with a sequence controller and timer to start one compressor at a time to avoid power supply surge. The panel shall also have facility to operate refrigeration unit on auto/manual mode. In the auto mode, as soon as the milk temperature reaches to pre-set value, the compressor should be switched off to avoid freezing of milk.

6.2 Milk Tank Control Panel

The milk tank shall be provided with a wall mounted or tank mounted control panel (*see* Fig. 1) with timer to control the intermittent operation of the agitators and a digital temperature indicator to indicate the milk temperature to one decimal place with least count of 0.1 °C on continuous basis. It shall include suitable switch gears or Printed Circuit Board (PCB) etc as required for switching and protection. The agitator shall have interlocking arrangement with top cover opening limit switch. The limit switch shall put off the agitator as soon as the top cover opens up. Panel shall have provision for presetting temperature of BMC tank (not below the milk temperature 4 °C) for starting/stopping refrigeration compressors. Suitable battery backup is to be provided so that temperature can be indicated when there is no electric supply.

This can also be integrated with refrigeration control panel.

6.3 Switch Gear

Not less than one duty selection switch incorporating a marked OFF position shall be provided. Except where the milk agitator is designed to operate continuously during cooling and storage or where automatic delay is provided, the milk agitator and the condensing unit of a direct cooling system, shall normally operate together and shall be controlled automatically by the milk temperature controller.

An over-riding manual switch shall also be provided. Except where the tank is intended for direct pick-up without extra agitation before sampling, a time switch shall be provided to operate the milk agitator independently from other components for a period of not less than 2 minutes.

A periodic time switch may be fitted to operate the milk agitator for pre-set periods at pre-set intervals independently from other components. Provision may be made to operate the milk agitator during automatic cleaning.

6.4 Duty

Besides the controls required for completely stopping and disconnecting the machine from energy, at least the following control functions shall be incorporated:

a) 'Standby': cooling, agitation and cleaning 'OFF';
b) Cooling-automatic: automatic operation for cooling and agitation;
c) Cooling-manual: cooling and agitation by manual control; and
d) Agitation-manual: agitation by manual control;

A separate/in-built controlling unit, shall be provided for automatic cleaning purpose, if supplied with the tank.

6.4.1 *Periodic Timer/Programmable Controller*

To ensure permanently the homogeneity of the milk, a periodic timer shall be fitted to operate the milk agitator for pre-set periods at pre-set intervals of not more than one hour independently from other functions. However, the agitator motor can also be controlled as per requirement, shall be provided with a manual mode as an alternative.

7 ELECTRICAL EQUIPMENT

7.1 General

The electrical equipment shall be capable of ensuring continuous operation of the refrigerating equipment of the bulk milk cooling tanks.

7.1.1 *Electrical Security*

The manufacturer of bulk milk cooling tanks shall monitor each and every individual unit:

a) Leakage current : Leakage current
b) Resistance grounding connections : Resistance of earthing connections
c) Dielectric rigidity : Dielectric strength.

The test must be done on each and every completely assembled bulk milk cooling tank along with electrical equipment on the manufacturing line and not only on prototype alone.

8 SAFETY REQUIREMENTS

8.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause.

8.2 Mechanical hazards

8.2.1 *Lids and Covers*

For open tanks, the open and closed positions of the lid shall be stable. The opening and closing operations shall require an intentional action hinged lids of open tanks shall have a mean to keep them in the open position (for example, spring, hook and bracket) or the center of gravity of the lid shall be at least 15° over the balancing position.

For closed tanks having one or more manholes, the locking of the cover of this manhole(s) in the closed position shall require an intentional action. Furthermore, it shall be clearly and visibly marked, adjacent to the manhole(s), that before the closing of the cover, it shall be checked that nobody is in the vessel; before entering the tank, it shall be necessary to read the instruction handbook. For reasons of hygiene, the design should avoid as much as possible the need to enter the tank.

8.2.2 *Agitators*

Access to the agitator attached to the lid of open

tanks shall be safeguarded by interlocking the lid with the agitator movement. When the lid is opened, the agitator shall stop within 2 s. For agitators not attached to the lid (closed tanks), a warning sign close to the manhole(s) or inspection opening(s) shall warn for the possible automatic start of the agitator.

8.2.3 *Refrigerating System*

The refrigerating system shall comply with IS 16678 (Parts 1 to 4).

8.2.4 *Stability*

Tanks shall be stable independent of the level of filling. If not stable by itself, the manufacturer shall define the fixing mode. Tanks with a mass of 75 kg or more when empty shall be so constructed that under normal operating conditions, it shall not tilt when subjected to an external horizontal force of 750 N applied in any direction at any accessible points by a suitable device. If the tank is equipped with a step or a platform, it shall not tilt when subjected to an external vertical force of 1 200 N applied on this step or platform. The manufacturer shall submit self-declaration of stability.

8.3 Electrical Hazards

Electrical hazards, in the form of shocks, burns, injury, fire and explosion etc, should be avoided/managed effectively which may threaten the safety of people and property.

8.4 Thermal Hazards and Hazards Generated by Materials and Substances Used

As far as technically possible, the design of automatic cleaning equipment shall ensure that no cleaning products and hot water can be splashed or sprayed against an operator either during 'pick up' of concentrated product or during the cleaning cycle (e.g. hoses tightened (for example spanner) or tubing fastened (clips), shields over product dispensing units). The temperature of the touchable outside walls shall conform to **4.2.1** of ISO 13732-1 for a time of contact 1 s. If it is not technically possible to achieve this for specific parts, safety sign(s) shall warn about the remaining hazards and the instruction handbook shall give advice on the use of proper protective wear (*see* **15.2.3**).

8.5 Hygiene

8.5.1 *Prevention of Milk Contamination*

8.5.1.1 The following parts shall be considered to be in the food area:

a) Inside surfaces of the inner vessel;
b) Outside surfaces of components inside the inner vessel;
c) The inner part of the lid(s); and
d) The inner part of the outlet including valve and connections.

NOTE — The manufacturer shall define adequate solutions for cleaning and disinfection.

8.5.1.2 The following parts shall be considered to be in the splash area:

a) outside parts of the equipment at the proximity of manholes, and
b) other openings where splashing can occur.

NOTE — The manufacturer shall define the size of this area on a basis of a risk assessment. The inner parts of the cleaning circuit shall comply with the requirements for splash areas.

8.5.1.3 Materials in contact with cleaning water and chemicals shall be resistant to cleaning and disinfecting agents in normal conditions of dosage and temperature so that they shall not impart a taint to milk.

8.5.2 *Cleaning*

The inner vessel shall be designed to be cleanable. If access to the inner vessel is made by manhole, equipment shall be provided for efficient cleaning without entering the vessel. The automatic cleaning equipment for closed shape coolers with manhole, shall comply with Annex B.

8.6 Ergonomics

Covers shall be so designed and constructed that during the opening and closing operations the ergonomic requirements of EN 1005-3 are fully met. For closed tanks, if the height of the rim of the manhole from the floor is more than 1.35 m, the manufacturer shall provide appropriate means of safe access:

a) a platform shall be fixed to the tank, and shall comply with the following requirements:

   1) the height from the platform to the rim of the tank shall be not less than 1 m and not more than 1.35 m;

   2) the platform dimensions shall be at least 300 mm wide and 250 mm deep;

b) if the distance from the floor to the platform is more than 450 mm, step(s) shall be provided; and

c) for platforms height above 1.20 m, platform and step(s) shall be in accordance with IS 16809-2 and IS 16809-3.

If access to the rear inlet is needed by the user, the requirements above shall apply. However, in casethe man hole is accessible from the steps/ ladder, platform may not be provided.

8.7 Provisions for Maintenance

As the tank is provided to operate under automatic control, the hazard due to unexpected start-up exists only during maintenance operations. Then it shall be able to be safely disconnected from electrical supply. If the electrical disconnecting device is not visible from the maintenance operating points, it shall be lockable. If the lockable disconnecting device is not a part of the tank, information shall be given in the instruction handbook

8.8 Other General Requirements for Tanks

8.8.1 *Temperature Resistance*

The tank and associated equipment shall be designed and constructed to withstand the following temperatures:

a) operation from + 5 °C to SOT
b) storage and transport under ambient temperature conditions
c) cleaning water up to + 90 °C for 2 min up to + 70 °C continuously.

NOTE — This requirement may be verified by ensuring that the bulk milk cooling tank and associated equipment do not undergo any physical deformity under the above conditions

9 PERFORMANCE PARAMETERS AND TESTS

9.1 Performance

For performance requirements, refer **5.3.1.**

9.1.1 *Milk Cooling Rate*

If a tank for two milking is either empty or contains 50 percent of its rated volume of milk at 4 °C, and 50 percent of the rated volume of milk at 35 °C is added in one batch, all of the milk shall be cooled to 4 °C in not more than the specified cooling time.

If a tank for four milkings is either empty or contains 25 percent, 50 percent or 75 percent of the rated volume of milk at 4 °C, and 25 percent of the rated volume of milk at 35 °C is added in one batch; all of the milk shall be cooled to 4 °C in not more than the specified cooling time.

If the volume of milk corresponding to the second milking is added to the tank, the total volume of milk shall be cooled from 10 °C to 4 °C in not more than the specified cooling time. The above requirements shall apply at ambient temperatures between 5 °C and the specified performance temperature (PT).

NOTE — As a design validation, during manufacturing of BMC, cooling test may be done with water periodically and also if there is any design change; thereafter same shall be checked with milk at site.

9.2 Storage of Milk

Under normal operating conditions, the mean temperature of the milk between cooling periods shall not be higher than 4 °C for tanks for four milkings and 5 °C for tanks for two milkings and none of the milk shall exceed 9 °C. This requirement shall apply at ambient temperatures between 5 °C and the specified performance temperature (PT).

The tank shall be provided with thermal insulation the efficiency of which shall be such that at the specified performance temperature (PT) the rate of rise of the mean temperature of the milk, initially at about 4 °C, shall not exceed 1 °C in 4 h when the rated volume is allowed to stand undisturbed.

9.3 Cooling Tests

9.3.1 *Fundamentals*

9.3.1.1 *Ambient temperature*

Measure the ambient temperature with a precision of ± 0.5 °C.

a) Mean of the temperatures

The temperature at each point measured shall remain constant within ± 2 °C throughout the period of the test. The mean of the temperatures measured shall remain equal to specified ambient temperature within ± 1 °C throughout the test. The mean temperature shall include all temperatures measured at points round the tank and in front of the condenser(s).

b) Location of measuring points

Halfway up the outer casing, at a distance of 100 ± 10 mm from the tank walls evenly spaced out over the tank periphery.
At a distance of 100 ± 10 mm in front of the air cooled condenser and evenly spaced out over its intake surface area.

c) Number of measuring points

1) When the greatest external dimension of the tank is less than or equal to 2 m:

i) at least one measuring point for each side wall; or,
ii) at least four measuring points equally distributed around cylindrical tanks.

2) When the greatest external dimension of the tank is between 2 m and 3 m:

i) at least one measuring point for each of the smaller walls; or,
ii) at least two measuring points about a meter apart for each of the larger walls.

3) When the greatest external dimension of the tank is greater than 3 m:

i) at least one measuring point for each of the smaller walls; or
ii) at least three measuring points about a meter apart from one another for each of the larger walls.

d) Vertical temperature gradient – 2 °C/m, *Max*.

9.3.1.2 *Air movement*

The tank and condensing unit shall be sited within the test area so that the velocity of air through the condensing unit shall not be influenced by external factors. The velocity of air touching the outer wall of the tank, the condensing unit being inoperative, shall not exceed 0.5 m/s.

9.3.1.3 *Electricity supply*

The supply voltage shall be within ± 5 percent of that stated in the instructions for use or on the identification plate of the tank. The frequency shall be the nominal frequency within ± 1 percent.

9.3.1.4 *Precision of measurement of volume*

Measure the volume of each 'milking' with a precision of ± 0.5 percent.

9.3.1.5 *Temperature of the test liquid*

a) For open types tanks

1) During storage and before mixing, measure the temperature at a point within 5 mm of the surface and also within 40 mm of the outlet and at other points deemed necessary by the testing station for open type tanks; and

2) During cooling and mixing after storage, measure the milk temperature at one or more points situated at least 20 mm from the walls, bottom and surface level and not less than 100 mm from the cooling surface.

b) For closed type tanks

During cooling and mixing after storage, measure the test liquid temperature from man hole at test liquid surface top, middle and close to bottom surface.

9.3.1.6 *Frequency of measurement*

If a continuous recorder is not used make the following measurements:

a) During cooling of a milking

Frequency — At least once every 10 min with a minimum of eight observations during the cooling of one milking.

Quantities to be measured — Ambient temperature, milk temperature and reading of the kilowatt hour meter.

b) In the interval between cooling of successive milkings

Frequency — not less than once every 30 min. Quantities to be measured: ambient temperature and milk temperature.

c) Materials construction and finish

1) *General* — Check the tank against the requirements for materials, construction and finish. The results of the examinations described below may be supplemented by reliable data supplied by the manufacturer or applicant for the test.

The finish and operating characteristics shall be assessed by at least two representatives of the testing station, one of whom shall be the person who has had the major share in operating the tank during the testing. Special attention shall be paid to the tank's suitability for operation, for inspection of the amount of ice, for sampling and for cleaning. The suitability of the construction and support of the inner vessel, relative to measurement of the volume of milk by reference to linear measurements may

be assessed by the relevant authority.

2) *Quality of the welds* — Examine the quality of the welds visually or by other suitable means.

3) *Surface finish* — Assess surface finishes by means of a surface roughness measuring device or by using comparison plates.

4) *Radii* — Check the radius of the corners using suitable gauges.

5) *Cleanability* — If a tank is fitted with automatic or semi-automatic cleaning equipment check the effectiveness of cleaning by means of either a field test or a laboratory test or both. Check at least that when the equipment is used in accordance with the manufacturer's instructions all surfaces inside the inner vessel are wetted by the cleaning solution. The testing method shall be described in full detail in the test report. The use of internationally accepted methods for the examination of samples is recommended.

6) *Dimensions* — Check the following dimensions:

   i) distance between the tank and the floor;
   ii) distance between the outlet fitting and the floor;
   iii) size of the covers;
   iv) distance between the agitator coupling and the maximum milk level;
   v) diameter of milk inlet aperture;
   vi) diameter of milk outlet;
   vii) length of the thermometer scale; and
   viii) height of the figures if the thermometer has digital indication.

7) *Protection by outer casing and covers against ingress of water* — First check compliance with the requirements stated in **4.1.1**, **4.1.10** and **4.1.12.3** and then carry out the tests on electrical equipment or ensure the electrical equipment are certified with at least IP 23 described in IS/IEC 60529.

8) *Agitator — Measurement of circumferential force* — Measure this speed at the top of the blade using a suitable instrument.

9) *Discharge of test liquid* — Static drainage test: Test must be done in triplicates. Measure indirectly the volume of test liquid which drains in 1 min by determining the balance of milk remaining in the tank. Proceed as follows:

   Ensure that the tank is mounted in its reference position. Wet the interior walls of the tank with (40 ± 0.5) litres of test liquid at a temperature of 2 °C to 20 °C. Allow the outlet to remain open for (5 ± 0.5) min and then close it. Measure 40.0 litres of 'test liquid' with a precision of 0.1 l and at a temperature of 2 to 20 °C and add to the tank. Allow the outlet to remain open for (1.0 ± 0.02) min and then close it. Measure with a precision of ± 0.005 litres the volume of test liquid which discharges from the tank in (5 ± 0.5) min when the outlet is again opened. This volume should not be greater than 0.2 litres.

9.4 Controls

9.4.1 *Milk Temperature Control*

Check the correct operation of the thermostat, for example the temperature differential and the consistency of cut-out and cut- in. This may conveniently be done during the cooling and storage tests.

9.4.2 *Measuring Equipment*

Check that the instrument for measuring milk temperature is operating correctly. This may conveniently be carried out during the cooling and storage tests.

9.5 Refrigerating Equipment

9.5.1 *General*

Check that the refrigerating equipment complieswith IS 16678-1.

9.5.2 *Type of Refrigerant*

The manufacturer's assurance that the refrigerant used in the refrigerating system during the tests will be identical with that in each unit to be installed on farms may be accepted or check the type of refrigerant in the unit(s) by measuring at the same point both the temperature and the absolute pressure simultaneously at not less than one point in the saturated vapour phase of the refrigerating system when vapour and liquid are in equilibrium.

Measure the refrigerant temperature on the outer surface of the pipe with a precision of ± 0.5 °C whilst ensuring that the measuring point is adequately insulated from the ambient atmosphere. Measure the pressure with a precision of ± 10 kPa (0.1 bar) by connecting a manometer to a suitable connection to be provided by the manufacturer.

9.6 Electrical Equipment

Inspect the electrical equipment generally to ensure that no obvious faults are present.

9.7 Cooling Tests

9.7.1 *General*

9.7.1.1 Locate the milk tank and the condensing unit in a room in which the ambient temperature is maintained continuously at the specified performance temperature (PT).

9.7.1.2 Carry out all tests in duplicate.

9.7.1.3 Liquid to be cooled: 'test liquid'

9.7.1.4 Filling: measure the daily refrigerating capacity and cooling rate using a test which represents the daily operation. The test for tanks for four milking differs from the test for tanks for two milkings only in the quantities of milk which are cooled (25 ± 0.5) percent and (50 ± 0.5) percent of the rated volume respectively.

9.7.1.5 Temperature of the milking to be added: (35 ± 0.1) °C.

9.7.1.6 As soon as the temperature of the milk has been reduced to (4 ± 0.1) °C, switch off the refrigerating plant.

9.7.1.7 Before draining the milk, cool it to a temperature which is the mean of the milk thermostat cut-in and -out temperatures at 100 percent filling. It will therefore be necessary to measure these temperatures during or before the cooling tests.

9.7.1.8 Measure the consumption of electricity using a kWh meter during the first and the duplicate cycles.

9.7.1.9 If the operation of the equipment is not satisfactory, additional measurements may be made in order to locate the source of trouble, for example refrigerant pressures, chilled water temperature around the inner vessel by measuring inlet and outlet temperatures. The manufacturer shall be responsible for the correction of faults.

9.8 *Direct Cooling Systems*

9.8.1 Before adding the first 'milking' to the tank maintain the ambient temperature at the performance temperature (PT) for 24 h immediately prior to and throughout the period of the test.

9.8.2 Immediately prior to adding a new milking ensure that the temperature of the milk already in the tank is 4.0 °C.

9.8.3 In order to reduce labour costs by working normal hours, the usual procedure of cooling successive milking every 12 h may be changed. ln such cases, instead of directly measuring the total electricity consumption using a kWh meter, this total may be derived by adding together the consumptions relating to the following periods:

9.8.3.1 *Cooling times*

Use a kilowatt hour meter to measure the power consumption of the complete installation during the cooling time for each milking.

9.8.3.2 *Periods between cooling times*

Calculate the total of periods between cooling times by subtracting the total of cooling times from the cooling cycle. Calculate the temperature rise of the milk during this (total) period using the mean temperature rise during the thermal insulation test (*see* **11**). Calculate the electricity consumption required to compensate 80 percent of the above calculated temperature rise when cooling 100 percent of the rated volume of milk using the cooling curve (*see* **9.7.1**) and especially that part from 4 °C to the mean cut-in and cut-out temperature.

NOTE — The need for this usage of electricity results from the temperature rise following absorption of heat from the surroundings. The figure of 80 percent is chosen because during the operating cycle the tank is not filled all the time to 100 percent of its rated volume.

9.8.3.3 *Cooling below 4 °C*

For the last milking only, calculate the electricity consumption required to cool the appropriate

filling from 4.0 °C to the mean of the thermostat cut-in and cut-out temperatures when the tank is filled to 100 percent of its rated volume. The mean temperature is the usual temperature of milk when delivered.

NOTE — The above applies only to the last milking because the energy consumed when cooling a previous milking to below 3.5 °C is compensated by cooling the next milking.

9.8.3.4 *Periodic agitation*

Calculate the electricity consumed during periodic agitation from the power input of the agitator motor and the time that the motor is running excluding the cooling time.

10 SAFE OPERATING TEMPERATURE (SOT)

The tank shall be able to cool any milking as detailed in above, under automatic control, when the equipment is operated at the specified SOT. To check that the equipment continues to function at the safe operating temperature (SOT) cool a first milking of (50 ± 0.5) percent or (25 ± 0.5) percent of rated volume for 2 milkings and 4 milkings respectively from 35 °C to 4 °C using automatic control.

11 THERMAL INSULATION TEST

The tank shall be provided with thermal insulation the efficiency of which shall be such that at the PT the rate of rise of the mean temperature of the milk, initially at about + 4 °C, shall not exceed +3 °C in 12 h when the rated volume is allowed to stand undisturbed, without agitation nor refrigeration.

11.1 Locate the tank, in a room in which the ambient temperature is maintained at the specified performance temperature (PT) ± 1.0 °C for a period of not less than 12 h before the test begins and throughout the test period.

11.2 Fill the inner vessel of the tank to its rated volume to normal working level, with water at (4.0 ± 0.5) °C.

11.3 Bring the contents of the inner vessel to a uniform temperature of (4.0 ± 0.5) °C measured with a precision of ± 0.1 °C. Place all covers in position and leave the equipment undisturbed for (12 ± 0.1) h.

11.4 During this 12 h period, measure the hot point of the milk (*see* **3.29**) at a position decided by the test station in the light of experience. Make not less than one measurement at a position which is less than 40 mm from the outlet.

11.5 At the end of the 12 h test period, bring the water in the tank to a uniform temperature measured with a precision not less than ± 0.1 °C and calculate the mean temperature rise of the water in the tank.

11.6 Storage of milk under normal conditions: If a hot point greater than 9 °C is observed during the thermal insulation test, check if it is still present under normal operating conditions at the specified performance temperature (PT).

12 FREEZING OF MILK

12.1 This test may be omitted if it is known from the construction and/or operation of the tank that ice can not form in the milk.

12.2 The test may be carried out using either water or raw milk. The water test is included because it is both simpler and cheaper but it should be appreciated that if freezing occurs, this will need to be checked by repeating the test using milk.

12.2.1 In an ambient temperature of 5 °C, fill the tank to (10 ± 2) percent of its rated volume with water at (35 ± 1) °C and commence cooling. As soon as cooling is stopped by the operation of the milk temperature control, drain the water from the tank, and at the same time check for the presence of ice by means of a stick or by another method. Note the areas where ice has formed and then melt it off. Repeat the test if no ice forms.

12.2.2 If ice forms during test as per **12.2.1**, repeat the test using milk in place of milk in place of water. Ice forms less readily in milk than in water.

12.2.3 If there are indications that ice may form at a higher ambient temperature and/or with more milk in the tank, repeat the test at this ambient temperature and/or filling. For example, if the equipment is fitted with a control designed to reduce cooling capacity at a certain ambient temperature repeat the test in an ambient temperature slightly above that at which the control is set to operate.

13 AGITATION OF MILK

13.1 Operating of the agitator shall not cause milk to overflow when the tank contains any volume of milk up to 100 percent of its rated volume. The shall be capable of producing a uniform distribution of the fat throughout the milk, so that the fat content agitator of samples, randomly selected from the

tank, does not differ by more than 0.1 g of fat per 100 g of milk. This requirement shall be achieved by operating the agitator for not more than 2 min, when the tank contains any volume of milk between 10 percent and 100 percent of its rated volume at + 4 °C and after allowing to stand unagitated for 1 h. For tanks utilizing a continuous agitation system, this requirement shall be achieved by operating the agitator for not more than 10 min. These requirements shall be achieved without the formation of froth or butter. The milk used for these agitation tests shall be bulk raw whole milk with fat content of (4 ± 0.5) g per 100 g of milk at a temperature of (4 ± 1) °C.

NOTE — During manufacturing of BMC, agitation test may be done with water and; thereafter same shall be checked with milk at site.

13.2 The test shall be done as below:

13.2.1 The milk shall be sampled in accordance with the guidelines set out in Annex C.

13.2.2 Fill the tank to 100 percent rated volume with milk.

13.2.3 Agitate the milk for a period of 2 min.

13.2.4 Take samples of the milk, in accordance with the guidelines set out in Annex C.

13.2.5 Store the milk for a period of 60 min, without any agitation or cooling.

13.2.6 Agitate the milk for a period of 2 min, for tanks designed for continuous agitation for a period of 10 min.

13.2.7 Take samples of the milk in accordance with the guidelines set out in Annex C.

13.2.8 Repeat the test with the inner vessel filled to 10 percent rated volume.

13.2.9 If there is an indication that there may be incomplete agitation at an inner vessel volume different to 100 percent and 10 percent, then carry out a test at this volume.

13.2.10 During these milk mixing tests check that there is no formation of froth or butter.

13.2.11 If a tank is fitted with a continuous agitation system, the samples shall be taken 10 min after the 60 min standing period. In addition the tank shall be left to operate in a normal manner for a period of 6 h to ensure that froth or butter are not formed.

14 CALIBRATION OF TANK

14.1 For design qualification, after its calibration at manufacturing unit is completed, the BMC in its reference position shall be filled with water at its nominal volume and emptied once per day for continuously 20 days. The condensing unit shall operate under normal utilization conditions. BMC will be full of water for at least 10 h per day everyday and then water is removed and filled again every day. The level of water shall be measured by the dipstick at each filling. The measured levels due to tank deformation shall not vary more than 1 mm. One sample is to be tested for one design/model.

14.2 For routine qualification while manufacturing, after its calibration at manufacturing unit is completed, the BMC tank in its reference position shall be filled with water at its nominal volume and emptied once per hour for continuously 3 times. BMC will be full of water for at least 1 h and then water is removed and filled again for every trial. The level of water shall be measured by the dipstick at each filling. The measured levels due to tank deformation shall not vary more than 1 mm.

15 TEST REPORT

15.1 General

The test report shall include the following:

a) Name and address of the applicant for the test (for example, manufacturer, buyer, agent, etc.);
b) Manufacturer’s name and trade name;
c) Type and serial number;
d) Performance class(es);
e) Description of the model of the tank;
f) Overall dimensions of the tank, including the agitator and the condensing unit if separate;
g) Appropriate technical information and manufacturer's names or trade names for major component parts relating to materials, construction and dimensions, as well as means for identifying separate components;
h) Type and charge of refrigerant used in the tests;
j) Material and method of thermal insulation;
k) Nominal information for each electric motor;
m) Date and duration of the test;
n) Results of the tests;
p) Average cooling performance in kilojoules per hour or in kilowatts for each cooling cycle;

q) A completed summary of test report according to Annex D. This shall include an English text; and
r) Name and address(es) of the testing station(s) which carried out the test.

15.2 Useful Information and Instructions

15.2.1 *General*

General Information for use shall be provided as required in the present clause.

15.2.2 *Warning Signs*

At least the following specific safety signs shall be provided:

a) A waterproof label adjacent to the manhole stating the following:

"Before entering the tank: Isolate the tank electrically and take the complementary precautions as described in the instruction handbook.

Before closing the cover: It must be checked that nobody is in the tank."

b) Where relevant, a warning sign for hot surface temperature as below should be given as per IS 16451.

Warning sign IS 16451 − W017: Warning; Hot surface

c) If the risk of contact with hazardous cleaning products cannot be completely excluded by design, appropriate warning signs (depending on the specific products and the process). The safety signals shall comply with IS 16503 (Part 1).

15.2.3 *Instruction Handbook for the User*

The instruction handbook shall meet the requirements and advice of **6.4.5** of IS 16819. The following specific information shall be included:

a) Details of general construction, including dimensions and the mass;
b) Identification of the major components;
c) Detailed operational guide, including an explanation of any marking using a symbol;
d) Details of any user maintenance required together with frequency;
e) The limits that shall be respected and the measures to be taken for ensuring stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable breakdowns;
f) Information on how to deal with a breakdown;
g) Safety precautions concerning the significant hazards as e.g., cleaning products handling; recommendation about the cleaning products to be used and not to be used; unexpected start-up;
h) Safety precautions for maintenance and similar interventions, and for exceptional cases when the user needs to enter the inner vessel:
   1) Measures for bringing the equipment to zero energy state like disconnect the machine from all the energy sources; precautions against unintended reconnection; neutralisation of residual energy (e.g., capacitors); verification of the safe state;
   2) Information on means to get into the tank and to get out of the tank in safe and easy conditions (e.g.,a ladder);
   3) Means for ensuring the safety of the intervention itself (including the use of protective extra low voltage (PELV) where relevant).
j) Elements of training to be given to operators; and
k) Draw attention for arrangements to be made by the user to ensure that the cards giving instructions for daily check list for operation and milk collection are made available to the operator.

15.2.4 *Instructions Check List*

15.2.4.1 *Instructions check list for day to day operation*

The manufacturer shall supply a card with simple

and clear instructions, at the time the tank is installed, detailing the safe operational and effective cleaning procedures required. The above instructions shall include at least the following:

a) mode of operation, including inspection requirements prior to commencement of milking;
b) the limits that shall be respected and the measures to be taken for ensuring stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable breakdowns; and
c) method of tank cleaning, including details of chemicals and maximum/minimum cleaning water temperatures recommended by the manufacturer, together with recommended quantities.

This card shall be durable and waterproof and shall be placed either on the tank or near the tank in a prominent position.

15.2.4.2 *Instructions check list for milk collection*

The user at the time the tank is installed shall be supplied with a card giving simple and clear instructions detailing the correct collection procedure to be followed to ensure accurate and rapid milk collection. When the tank is equipped with an automatic cleaning system, a clear procedure to start the system shall be indicated. This card shall be durable and water proof and shall be placed either on the tank or near the tank in a prominent position.

15.2.5 *Installation and Maintenance Instructions*

A warning shall indicate that it is essential to stop and isolate the agitator before entering the inner vessel. The installer shall be supplied with a set of instructions detailing the correct installation, handling and maintenance procedures.

The following information shall be supplied:

a) the information detailed on the main components;
b) the limits that shall be respected and the measures to be taken for ensuring stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable breakdowns;
c) the information detailed on the tank data plates/labels;
d) information on equipotential bonding;
e) if the tank is fitted with a time clock for the control of the condensing unit(s), instruction for programming it;
f) safety precautions before entering the inner vessel:
    1) Measures for bringing the equipment to zero energy state:
    2) Disconnect the machine from all the energy sources;
    3) Precautions against unintended reconnection;
    4) Neutralisation of residual energy (e.g. capacitors); and
    5) Verification of the safe state.
g) information on means to get into the tank and to get out of the tank in safe and easy conditions (e.g. a ladder);
h) information on how to move the tank into the required position;
j) Information on any special requirements that have to be carried out prior to the installation of the tank, that is. floor plates, drains, doorways. This information shall also be supplied to the farmer to enable the necessary work to be carried out prior to the installation:

    1) that sufficient clearance is provided around the tank to allow the outer casing to be periodically cleaned in accordance with hygiene regulations. A clearance of 500 mm is recommended;
    2) that the head room above the tank or platform is sufficient to permit the user and tanker driver to carry out their duties safely and without difficulty. A head clearance of not less than 2 m above any platform is recommended;
k) Details on how to level the tank to the required slope;
m) Special requirements on sitting the condensing units and sitting/sizing of refrigerant pipe work,
n) Layout schematics, including the refrigeration system;
p) Electrical wiring diagrams and/or schematics; and
q) Details of the water supply requirements necessary to ensure correct operation of the cleaning system;
r) Details of the required procedures for checking the tank cooling and cleaning systems; and
s) Trouble shooting charts detailing the most common faults likely to occur and the recommended correction procedures.

15.2.6 *Dismantling Instructions*

The user and installer shall be supplied with a set of instructions, at the time the tank is installed detailing the procedures required to allow the tank and all associated components to be safely dismantled.

15.2.7 *Minimum Marking*

15.2.7.1 All individual electrical components shall be provided with data plates/labels permanently

secured to the components. The data shall allow individual identification of the components.

15.2.7.2 The tank shall be fitted with data plates/labels carrying at least the following information:

a) The business name and full address of the manufacturer and, where applicable, his authorized representative;
b) Designation of the machinery;
c) Designation of series or type, if any;
d) Serial or identification number, if any;
e) Tank serial number;
f) Tank model and type code;
g) The year of construction, that is the year in which the manufacturing process is completed;
h) Rated volume expressed in liters;
j) Relevant performance classes;
k) Designation number of the refrigerant;
m) Refrigerant charge in kilograms;
n) Maximum allowable pressure, on high and low pressure side of the refrigerating system;
p) Rated voltage;
q) Rated frequency; and
r) Full load current.

15.2.7.3 The tank shall be permanently marked with the individual serial number as noted in **15.2.7.2**.

15.2.7.4 The marking shall be adjacent to the manhole or normal inspection position, on a permanent part of the body of the tank or inner vessel and carried out in digits not less than 4 mm high.

15.2.7.5 The main controls of the tank and cooling system shall be marked so that it is obvious how the equipment is to be operated. If symbols are used their meaning shall be explained in the main instructions.

16 MARKING

16.1 The tank shall be marked legibly and permanently with the following particulars:

a) Manufacturer's name or trade-mark or initials;
b) Manufacturer's identification;
c) Capacity of the tank;
d) Refrigerating capacity on condensing unit shall be stated in kcal/h or TR or kW at a saturated suction temperature designated by the manufacturer; and
e) Relevant performance temperature(s) as per **5.3.1**.

16.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No./Other Publications	*Title*
IS 1224 (Part 1) : 1977	Determination of fat by gerber method: Part 1 Milk (*first revision*)
IS 3382 : 1965	Specification for stainless steel milk pipes and fittings
IS 5522 : 2014	Stainless steel sheets and strips for utensils — Specification (*third revision*)
IS 6911 : 2017	Stainless steel plate, sheet and strip — Specification (*second revision*)
IS 10500 : 2012	Drinking water — Specification (*second revision*)
IS 16451 : 2018/ISO 7010 : 2011	Graphical symbol — Safety colours and safety signs — Registered safety signs
IS 16503 (Part 1) : 2017/ IEC 61310-1 : 2007	Safety of machinery — Indication marking and actuation: Part 1 Requirements for visual, acoustic and tactile signals
IS 16656 : 2017/ISO 817 : 2014	Refrigerants — Designation and safety classification
IS 16809	Safety of machinery — Permanent means of access to machinery
(Part 2 : 2018)/ISO 14122-2 : 2016	Working platforms and walkways
(Part 3 : 2018)/ISO 14122-3 : 2016	Staris, stepladders and guard-rails
IS 16678	Refrigerating systems and heat pumps — Safety and environmental requirements
(Part 1 : 2018)/ ISO 5149-1 : 2014	Definitions, classification and selection criteria
(Part 2 : 2018)/ ISO 5149-2 : 2014	Design, construction, testing, marking and documentation
(Part 3 : 2018)/ ISO 5149-4 : 2014	Installation site
(Part 4 : 2018)/ ISO 5149-4 : 2014	Operation, maintenance, repair and recovery
IS 16819 : 2018/ISO 12100 : 2010	Safety of machinery — General principles for design — Risk assessment and risk reduction
IS/IEC 60529 : 2001	Degrres of protection provided by enclosures (IP Code)
ISO 1211 : 2010	Milk — Determination of fat content — Gravimetric method (Reference method)
ISO 13732-1 : 2006	Ergonomics of the thermal environment — Methods for the assessment of human responces tocontact with surfaces Part 1: Hot surfaces
EN 1005-3 : 2002	Safety of machinery — Human physical performance — Recommended force limits for machinery operation

ANNEX B
(*Clause* 8.5.2)

TEST FOR CLEANABILITY AND CLEANING PERFORMANCE

B-1 INTRODUCTION

This annexure describes a standard test for the assessment of the cleanability and cleaning performance of a tank with automatic cleaning equipment or manual cleaning

B-2 DEFINITIONS AND STEPS FOR THE TEST

B-2.1 Standardized Soiling Procedure

Soiling with naturally coagulated raw milk.

B-2.2 Cleaning

Cleaning by automatic or manual cycle according to the manufacturer's instructions in the instruction handbook.

B-2.3 Evaluation of Cleaning Results

Evaluation for the cleaning of the inner surfaces of the refrigerated milk tank and other specified parts of the tank e.g., outlet, agitator and dipstick which includes:

a) An examination of chemical residues (*see* **B-12**).
b) A visual inspection using a bright light (*see* **B-8** and **B-10**); and
c) A measurement of the residual bacterial pollution;
   1) for the tank outlet:
      i) by rinse procedure (*see* **B-9.2**);
   2) for internal surfaces and equipment two methods are used:
      i) By rinsing procedure (*see* **B-9.3.1**); and
      ii) By swabbing procedure (*see* **B-9.3.2**).

B-2.4 The criteria for acceptable cleanability when assessed by this annex are as follows:

a) chemical residues: less than acceptable concentration;
b) milk residues: not detectable; and
c) microbiological contamination (*Max.*):
   1) Tank outlet: Aerobic plate count 5 000 colony forming units per milliliter (cfu/ml) of rinse water; and Coliform count 100 colony forming units per millilitre (cfu/ml) of rinse water;
   2) Tank surfaces: Aerobic plate count 5 000 colony forming units per 900 square centimetre (cfu/cm^2); and Coliform count 100 colony forming units per 900 square centimeter (cfu/cm^2).

B-3 INSTALLATION OF THE TANK TO BE TESTED

B-3.1 Connection and Installation of the Tank in its Reference Position

B-3.1.1 Install the tank in its reference position.

B-3.1.2 Connect the tank to the water(s) supply. Install a device in order to allow samples of the water (s) feeding the tank.

B-3.1.3 Check the real dimension of the internal surface of the tank.

B.3.1.4 Measure the exact volume of the outlet drainage pipe, as follows:

a) Install the measuring equipment;
b) Ensure that the pinchcock is closed and that the outlet valve of the tank is opened;
c) Fill the volume of the outlet with water (as far as the upper edges of the outlet inside the tank);
d) Closed and open the outlet valve, if any, to make this measurement very precise; and
e) Open the pinchcock and collect the water;
f) Record this volume (V_1).

B-3.2 First Automatic or Manual Cleaning Cycle

B-3.2.1 Carry out the automatic or manual cleaning cycle once.

B-3.2.2 When the automatic or manual cleaning cycle is running, make a full check to see that it operates in accordance with the manufacturer's instructions/operating manual with respect to the following details:

a) Initial rinses preferably with potable water — Number and volume of rinses; to remove all loosely attached milk residues and other deposits, if any.
b) Wash stage — Detergent/formulated food grade cleaning chemical concentration, volume of wash solution, wash temperature (initial and final) and time

and duration of wash cycle; with details:

1) In case of manual cleaning, rub the surface using long handled hygienic nylon or any other suitable food grade brush to loosen the residues stuck on the walls.
2) In case of automatic CIP, circulation with adequate flow rate considering tank design and connected pipelines (including milk loading lines and the transfer pipelines) diameter to meet turbulence requirement of more than 1.5 m/s.

c) Intermediate rinses preferably with potable *water* — Number and volume; to remove all chemical residues.
d) Disinfection stage — Formulated food grade sanitizing chemical or hot water (80 °C for 15 minutes), volume, concentration and contact time.
e) Final rinses with potable water (*see* IS 10500) — Number and volume of rinses, to remove the disinfectant residues.

NOTE — Where potable water is not available, formulated food grade chemical (specially formulated for this purpose) may be added to final rinse water to maintain the sanitary conditions of water.

B-3.2.3 Measure the volumes of water (s) with a limit deviation of ± 5 percent.

B-3.3 After a Complete Automatic or Manual Cleaning Cycle

After the complete automatic cleaning cycle, leave the tank at rest with all the covers and outlets opened until the beginning of the soiling procedure as described in **B-5**, at least 12 h.

B-4 PREPARATION OF SOILING MILK (SOLUTION A)

B-4.1 Use bulk raw whole milk of the following composition:

Fat with a mass fraction of ≥ 3.0 percent;
SNF with a mass fraction of ≥ 8.0 percent;

NOTE — The mass fraction is the number of grams of solute (solid) in 100 g of product.

B-4.2 Add 1.5 percent bromocresol purple (0.1 percent concentration) to the total volume milk.

NOTE — The volume fraction is the number of grams of solute (solid) in 100 ml of product.

B-4.3 Incubate at 30 °C – 35 °C until colour of the milk changes to clear yellow (*p*H 4.6).

B-4.4 Prepare a quantity of the solution A of at least 0.5 litres/m^2 of the internal surfaces of the tank to be tested, with a minimum of 4 litres in any case, increased by the necessary quantity to feed the spraying pump.

B-4.5 Take a sample for bacteria counting (cfu/ml) of the solution A (*see* **B-11.1**).

B-4.6 Store the solution A at 3 °C to 5 °C until required time for soiling to the internal tank surfaces (maximum storage time: 24 h).

B-5 SOILING OF THE TANK

B-5.1 Use one of the sterilized spraying equipment.

B-5.2 Close the outlet and switch on the agitator.

B-5.3 Spray the solution A continuously on all the parts of the internal surfaces. If complete and even coverage is not obtained. Collect the solution A to drain from the tank. Collect this drained solution (solution B).

B-5.4 Take a sample for bacteria counting (cfu/ml) of the solution B (*see* **B-11.1**), in order to make sure that bacteria are still alive.

B-5.5 Close all the covers/openings except the outlet which remains opened.

B-5.6 Leave the solution A in contact with the tank internal surfaces for 4 h to 4 ½ h.

B-6 AUTOMATIC OR MANUAL CLEANING OF THE TANK

B-6.1 Carry out the automatic or manual cleaning cycle using one of the manufacturer's recommended products or product combinations (*see* **B-3.2.2**).

B-6.2 In the case when the instruction handbook sets out a postponed disinfection, this disinfection will be done according to the instruction handbook just after the end of the automatic or manual cleaning cycle.

B-6.3 Prepare a reference solution(s), as follows:

a) To prepare a reference solution for the automatic or manual cleaning cycle, solution L_1, mix alkali or products or product combinations used for the automatic cleaning cycle with the water(s) used for the automatic cleaning cycle in the same proportion as automatically done during the cleaning cycle (to obtain the

b) 'wash solution', (*see* **B-3.2.2**). For the volume of solution L_1 to prepare, (*see* **B-12.3.1)**.

c) To prepare a reference solution for the postponed disinfection, if any, solution L_2, mix disinfected products or product combinations used for the postponed disinfection with the adequate water(s) used for the postponed disinfection in the same proportion as automatically done during the postponed disinfection. For the preparation of the volume of solution L_2, (*see* **B-12.3.2**).

NOTES
1 Postponed disinfection means that after the cleaning cycle, the disinfection is deliberately delayed for a defined period, for example, 8 h to 16 h.
2 All the 3-way plug valves shall be opened and cleaned on daily basis prior to CIP activity.
3 Two butterfly valves may be used in place of 3 way valves for better hygienic engineering.

B-7 TANK REST PHASE

Leave the tank at rest during (16 ± 1) h after the cleaning cycle.

B-8 VISUAL ASSESSMENT OF INTERNAL TANK SURFACES AND EQUIPMENT

B-8.1 Carry out a visual assessment carefully, avoiding any contact or contamination which can affect subsequent microbiological evaluation.

B-8.2 Inspect all internal tank surfaces using a bright light source, noting the presence of any areas having visible residues of soil deposits.

B-8.3 Note in the test report the location of trace(s), if any.

B-8.4 Complete this examination after the swabbing procedure, (*see* **B-10**).

B-9 TESTING METHOD FOR BACTERIOLOGICAL EXAMINATIONS

B-9.1 Solutions and equipment used for bacteriological examinations.

B-9.1.1 Solutions and equipment used for the rinsing method.

B-9.1.1.1 Use the required equipment which is described in Annex B. Sterilise all the laboratory equipment used to sample and to prepare the solutions, for 15 min at 121 °C.

B-9.1.1.2 Prepare the following solution S_1, as given in **B-9.1.1.2.1** to **B-9.1.1.2.4**.

B-9.1.1.2.1 Prepare the volume V_2 of distilled or de-ionised water which shall be the addition of:

The volume V_1 required to fill the outlet (*see* **B-3.1.4**).

a) The volume required to be sprayed on each part of the internal surfaces of the tank (calculated with the rate of 0.5 l/m^2);
b) The volume provided to prime and rinse the pump;
c) The volume to prepare the dilution of solutions L_1 and L_2 (*see* **B-12.3**); and
d) The volume used for the swabs (*see* **B-9.3.2.1**).

B-9.1.1.2.2 Mix with V_2 a neutralizing buffer solution in the following proportions (quantities are given in grams per l):

Monopotassium phosphate	: 0.0425
Sodium thiosulphate	: 0.16
Polyoxyethylene sorbitan monooleate: ($C_{12}H_{10}CINO_3$)	: 5
Sodium hydroxide	: 0.008

Suitable commercial preparation allowing the preparation of this solution by dissolving the preparation in distilled or de-ionised water should be used.

B-9.1.1.2.3 Mix also V_2 with the necessary number of Ringer tablets in order to get a Ringer solution diluted at one quarter which is equivalent to the following ingredients (quantities are given in grams per litre):

Sodium chloride	: 2.250
Potassium chloride	: 0.106
Anhydrite calcium chloride	: 0.120
Sodium hydrogen-carbonate	: 0.050

B-9.1.1.2.4 Sterilise the solution S_1 for 15 min at 121 °C.

B-9.1.2 *Equipment Used for the Swabbing Method*

Sterilize or sanitize all the laboratory equipment used to swab and to prepare solutions, for 15 min at 121 °C.

B-9.2 Assessment of the Tank Outlet

B-9.2.1 Separate the tank outlet pipe from the cleaning system and fit the equipment, ensuring the pinchcock is closed and the outlet is opened.

B-9.2.2 Pour the volume V_1 (*see* **B-3.1.4**) of sterile solution S_1 into the outlet. Allow the solution S_1 to stand inside the outlet for 30 min and during this

time if there is an outlet valve in this part of the system, close it and open it once.

B-9.2.3 Open the pinchcock and collect the rinse (solution F_1) in a suitable sterile container. Mix it.

B-9.2.4 Take a sample for bacteria counting (cfu/ml) of the solution F_1 (*see* **B-11.1**).

B-9.3 Assessment of the Internal Tank Surfaces and Equipment

B-9.3.1 *General*

This assessment shall be done by two different methods: by rinsing method and by swabbing method.

B-9.3.2 *Rinsing Method*

B-9.3.2.1 Remove the equipment used for the assessment of the tank outlet. Leave the outlet open. Install a suitable container in order to collect all sprayed water (*see* **B-9.3.2.3**) via the outlet.

B-9.3.2.2 Use the second sterilized spraying equipment.

B-9.3.2.3 Run the pump to spray solution S_1. Leave at least (2 ± 0.5) l of the solution S_1 flowing as far as its required rate. Take a sample of this sprayed solution for bacteria counting (solution S_2), in order to be sure that the solution S_1 is not polluted by the spraying equipment (*see* **B-11.1** for the storage of the solution S_2).

B-9.3.2.4 Open the manhole and spray the solution S_1 continuously on all parts of the internal tank surfaces and equipment

B-9.3.2.5 Note the total volume of solution S_1 sprayed into the tank (named V_3).

B-9.3.2.6 Leave the tank at rest 5 min time.

B-9.3.2.7 Note the volume (named V_4) of the collected rinse solution (solution F_2). Mix it.

B-9.3.2.8 Take a sample for bacteria counting (cfu/ml) of the solution F_2 (*see* **B-11.1**).

B-9.3.2.9 Take a sample of at least 50 ml of solution F_2 for chemical examination.

B-9.3.3 *Swabbing Method*

B-9.3.3.1 Put inside each test tube with swab, 5 ml of solution S_1. Apply the plastic mask on provided location.

B-9.3.3.2 Extract the swab from the test tube containing the solution S_1, eliminate the excessive solution S_1 by pushing the swab against the internal wall of the test tube and by twisting the swab in the air, to obtain a wet swab.

B-9.3.3.3 Press the swab on the surface to be tested, in the free area of the plastic mask. Move the swab from one side to the opposite forming parallel lines. On the whole surface to be tested. Avoid rotation with the swab. More than one way on the same line is not necessary.

B-9.3.3.4 Use the opposite face of the swab and press it on the same surface. Move the swab from one side to the opposite forming parallel lines angled 90° to the lines formed in **B**.**9.3.3.4**.

B-9.3.3.5 Put the swab back to its test tube and shake it by hand in order to mix the potential bacterial pollution with the neutral solution S_1.

B-9.3.3.6 Repeat the same procedure on the 7 different locations, designated as G_1 to G_7.

B-9.3.3.7 Take a sample for bacteria counting (cfu/ml) of each of the solution in the test tubes, designated solution G_1 to G_7 (*see* **B-11.1** for the storage of these solutions).

B-10 VISUAL ASSESSMENT OF INTERNAL TANK SURFACES AND EQUIPMENT

B-10.1. Inspect all internal tank surfaces using bright light source noting the presence of any areas having visible residues of soil deposits.

B-10.2 Record the place of the traces, if any. Take swabs on these areas by following safety precautions.

B-11 BACTERIOLOGICAL EXAMINATION

B-11.1 Store each sample for bacteria counting (samples of solution A, B, F_1, F_2, G_1 to G_7 and S_2) in ice water until tested inside a period of maximum 24 h after the sample.

B-11.2 Shake 20 times each sample.

B-11.3 Prepare a diluent containing peptone 1 g and sodium chloride 8.5 g for 1 000 ml of water. Sterilise the diluent at 121 °C for 15 min.

B-11.4 Prepare for each sample dilution to 1/10 and a dilution to 1/100 using the diluent prepared in **B-11.3**.

B-11.5 Plate in triplicate 1 ml of each sample and

1 ml of each dilution of each sample in milk plate count agar. Use only sterile equipment to transfer solutions.

B-11.6 Add a suitable quantity of the following nutritional environment, mixed at 45 °C, inside each plate:

Yeast	: 2.5 g
Truptone	: 5.0 g
Glucose	: 1.0 g
Skimmed milk powder	: 1.0 g
Agar-agar	: 15.0 g
Water for 1 000 ml of solution.	

B-11.7 Leave the plates incubated at (30 ± 1) °C for (72 ± 2) h.

B-11.8 Count colonies inside each plate. If less than the quarter of the surface of the plate is covered by intrusive colonies, count colonies on the part with non-intrusive colonies and calculate the corresponding number for the whole plate. If more than the quarter of the plate is covered by intrusive colonies, do not take this plate into account.

B-11.9 Use the result of plates containing between 10 colonies and 300 colonies. Calculate the number of microorganisms per millilitre as follows:

$$\frac{\sum C}{1.n_1 + 0.1.n_2 + 0.01.n_3.d}$$

where

C = number of intrusive colonies counted on the plate;
n_1 = number of counted plate for the original solution;
n_2 = number of counted plate for solution with dilution 1/10;
n_3 = number of counted plate for solution with dilution 1/100;
D = solution from the first obtained counting.

B-11.10 Rinsing Method

Determine the final result per square metre of internal surface of the tank by determining the ratio between the number of microorganisms inside the total volume of the sprayed solution and the whole internal surface of the tank which has been sprayed.

B-11.11 Swabbing Procedure

Determine the final result per square metre of internal surface of the tank by determining the ratio between the number of microorganisms inside the solutions G_1 to G_7 and the surface under test.

B-12 CHEMICAL EXAMINATION

B-12.1 Use a *p*H metre of 1/100 reading.

B-12.2 Measure the *p*H of the solution F_2.

B-12.3 Prepare reference solutions, as follows:

B-12.3.1 Mix solutions S_1 and L_1 in order to obtain the following concentration of solution L_1:

a) A volume fraction of 1 percent of the solution L_1;
b) A volume fraction of 0.5 percent of the solution L_1;
c) A volume fraction of 0.3 percent of the solution L_1;
d) A volume fraction of 0.2 percent of the solution L_1; and
e) Avolume fraction of 0.1 percent of the solution L_1;

B-12.3.2 Measure the *p*H for each of these different concentrations in order to obtain a curve to read the concentration of L_1 (volume fraction) according to the *p*H.

B-12.3.3 Do the same operation for the solution L_2.

B-13 INTERPRETATION OF RESULTS

B-13.1 Chemical Evaluation

The maximum concentration of chemical product in the solution F_2 shall be a volume fraction of 0.5 percent.

B-13.2 Bacteriological Evaluation

The bacteria contamination of the tank outlet and of the tank surfaces shall be less than the acceptable criteria given in **B-2.4**. The solution S_2 shall contain less than 10 cfu/ml.

B-13.3 Visual Evaluation

No visible traces shall appear.

ANNEX C
(*Clauses* 13.2.1, 13.2.4 *and* 13.2.7)

SAMPLING METHODS FOR MILK MIXING TESTS

C-1 At least six samples of milk shall be taken at each of the two sampling times.

C-2 At least three of these shall be taken from the top layer of the milk surface. Not less than 90 percent of each sample shall be taken from the top 20 mm layer of the milk.

C-3 These three samples shall be taken from:

a) Close to the agitator;
b) As far as possible from the agitator; and
c) At a place where the agitation of the milk seems to be least.

C-4 At least another three samples shall be taken from the bottom of the inner vessel. Not less than 90 percent of each sample shall be taken from milk within 50 mm of the bottom of the inner vessel. One of these samples shall be from the area adjacent to the outlet.

C-5 Samples shall be taken with a ladle or suitable stain less steel milk sampler.

C-6 Samples shall be checked in accordance with the requirements of ISO 1211.

ANNEX D
[*Clause* 15.1, *Item* (*q*)]

SUMMARY OF TEST REPORT ON A REFRIGERATED BULK MILK TANK

1) TANK DETAILS

Manufacturer : .....
Trade name :.....
Type and serial number:.....
Rated volume :..... litres
Maximum volume :..... litres
Tank for ..... milkings
Direct/indirect cooling system:.....
Atmospheric/vacuum tank:.....

2) TECHNICAL DATA

a) Condensing Unit:
Manufacturer(s) or trade name(s):
Type and serial number :.....
Capacity : .....
Position of condensing unit with regard to tank : .....
Type and charge of refrigerant :…….

b) Vessel:
Manufacturer(s) or trade name(s) :…….
Model: .....
Material inner vessel :.....
Material outer casing : .....
Dimensions:
Maximum length outside: ..... mm
Maximum width outside : .... mm
Maximum height, lids opened :..... ..... mm
Height of upper edge inner vessel :..... mm

c) Agitator(s):
Manufacturer(s) or trade name(s) :…….
Number and type : .....
Number of blades per agitator : .....
Length of blades: ..... mm
Speed : ..... r/min
Continuous/periodic agitation :..... min every ..... hour

d) Manufacturer's name or trade name and type of : .....
Expansion valve :.....
Milk temperature controller :……..
Ice bank controller : ……...
Chilled water pump : ……..

e) Type and amount of intermediate coolant in litres (if applicable):…….

f) Cleaning by hand/automatic equipment :……

g) Supply voltage : ..... V; Frequency: ..... Hz; Rated electrical input: ..... kVA

3) RESULTS

Cooling times to 4 °C after filling with milk at 35 °C to rated volume:

Test No.	Ambient Temperature °C	Milkings 1st	2nd	3rd	4th	$1^{st} + 2^{nd}$ milkings 10 °C to 4 °C
		h	h	h	h	h
1						
2						
3						
4						
5						
6						

a) Specific energy consumption : ..... Wh/l milk
b) Freezing of milk at a filling of 10 percent of rated volume……..... did not/did occur
c) Rise in temperature of rated volume during insulation test for 12 h in ambient temperature of ..... °C was .....°C.
d) Maximum temperature in the milk during storage (hot point) was above/below 9 °C.

4) AGITATION

a) Effective mixing of the milk was found with…….percent of rated volume
b) Mixing capacity was unsatisfactory with ..... percent of rated volume
c) Further remarks on agitation : .....

Results of cleaning tests (if applicable): ..... satisfactory/unsatisfactory

Additional remarks:.....

ANNEX E

(*Foreword*)

COMMITTEE COMPOSITION

Dairy Products and Equipment Sectional Committee, FAD 19

Organization	*Representative(s)*
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